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L5	L4 AND ((AUCTION$ OR VIOD$) SAME (REWARD OR PENALT$))	6	L5
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   (FILE 'HOME' ENTERED AT 12:00:42 ON 17 DEC 2002)

     FILE 'USPAT2, EUROPATFULL, INPADOC, INSPEC, NLDB, PATOSEP, PATOSWO,
     JAPIO' ENTERED AT 12:01:20 ON 17 DEC 2002
L1          317 S ((AUCTION? OR BID?)(6A)(PENALT? OR REWARD?))
L2           28 S L1 AND RULE
L3            1 S L1 AND (MEET? (2W)CRITERIA)
L4            1 S L1 AND ((MEET? OR MATCH?) (2A)(LIMIT? OR CRITERIA))
L5           50 S L1 AND REGULAT?
L6           48 S L1 AND ((MEET? OR MATCH? OR FOLLOW?)(S)(REGULAT? OR STANDARDS
L7           14 S L1 AND ((MEET? OR MATCH? OR FOLLOW?)(S)(REQUIREMENTS OR GUIDE
L8           39 S L1 AND (((MEET? OR MATCH? OR FOLLOW?)(S)(GOALS OR CONSTRAINTS

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BID?

L3: Entry 5 of 8 File: USPT Jan 4, 2000

DOCUMENT-IDENTIFIER: US 6012039 A
TITLE: Tokenless biometric electronic rewards system

Abstract Text (1):
The method of the invention includes a tokenless authorization of a reward transaction between an issuer and a recipient using an electronic identicator and at least one recipient bid biometric sample, the method comprising the following steps. A recipient registration step, wherein a recipient registers with an electronic identicator at least one registration biometric sample. An issuer registration step, wherein the issuer registers identification data with the electronic identicator. During a transaction formation step, wherein an electronic reward transaction is formed between the issuer and the recipient, comprising issuer bid identification data, transaction data, and at least one recipient bid biometric sample, the bid biometric sample is obtained from the issuer's person. In at least one transmission step, the issuer bid identification data, the transaction data, and recipient bid biometric sample are electronically forwarded to the electronic identicator. In a recipient identification step, the electronic identicator compares the bid biometric sample with at least one registered biometric sample for producing either a successful or failed identification of the recipient. In an issuer identification step, the electronic identicator compares the issuer's bid identification data with an issuer's registered identification data for producing either a successful or failed identification of the issuer. Thereby, upon successful identification of the recipient and issuer, a reward transaction is authorized for debit or credit settlement of reward units from the recipient's rewards account, without the recipient presenting any personalized man-made tokens such as smartcards or magnetic swipe cards.

Brief Summary Text (22):
The present invention satisfies these needs by providing a significantly improved system and method for processing tokenless electronic rewards transactions between a rewards issuer and a rewards recipient using an electronic identicator and at least one biometric input apparatus. The method of the invention includes a tokenless authorization of a reward transaction between an issuer and a recipient using an electronic identicator and at least one recipient bid biometric sample, the method comprising the following steps. A recipient registration step, wherein a recipient registers with an electronic identicator at least one registration biometric sample. An issuer registration step, wherein the issuer registers identification data with the electronic identicator. During a transaction formation step, wherein an electronic reward transaction is formed between the issuer and the recipient, comprising issuer bid identification data, transaction data, and at least one recipient bid biometric sample, the bid biometric sample is obtained from the issuer's person. In at least one transmission step, the issuer bid identification data, the transaction data, and recipient bid biometric samples are electronically forwarded to the electronic identicator. In a recipient identification step, the electronic identicator compares the bid biometric sample with at least one registered biometric sample for producing either a successful or failed identification of the recipient. In an issuer identification step, the electronic identicator compares the issuer's bid identification data with an issuer's registered identification data for producing either a successful or failed identification of the issuer. Thereby, upon successful identification of the recipient and issuer, a reward transaction is authorized for debit or credit settlement of reward units from the recipient's rewards account, without the

recipient presenting any personalized man-made tokens such as smartcards or magnetic swipe cards.

Brief Summary Text (24):
The device of the system for tokenless transaction of electronic reward-units transfer to a recipient includes, an electronic identicator for comparing the bid and registered biometric samples of a recipient of reward units, and for comparing the bid and registration identification data of an issuer of reward units. It further includes a party identification apparatus for submission of the recipient's biometric samples and the issuer's identification data; an electronic reward registry of reward units, having the reward-units disbursed to a recipients based upon the occurrence of predetermined criteria. A recipient rewards account stores accrued reward units. Finally, an execution module debits and credits the recipient reward account based upon the occurrence of predetermined criteria. Therefore, no man made tokens such as cards or smartcards are presented for executing the transaction.

Brief Summary Text (25):
A method for processing tokenless electronic reward-units transfer to a recipient using an electronic identicator and at least one recipient biometric sample, includes creating an electronic registry of reward units, having the reward-units disbursed to a recipient based upon the occurrence of predetermined criteria. In a recipient registration step, wherein the recipient registers with the electronic identicator at least one registration biometric sample. In a recipient identification step, wherein the identicator compares a recipient bid biometric sample with at least one previously registered biometric samples for producing either a successful or failed identification of the recipient. Finally, in a recipient reward-units issuance step, upon successful identification of the recipient, a reward transaction is authorized for debit or credit settlement of reward units from the recipient's rewards account, without the recipient presenting any personalized man-made tokens such as smartcards or magnetic swipe cards.

Brief Summary Text (27):
The invention is clearly advantageous from a convenience standpoint to rewards issuers and rewards institutions by making electronic rewards transactions less cumbersome and more spontaneous. The paperwork of tokenless biometric rewards transactions is significantly less than that required with standard couponing and rewards transactions wherein the copies of the coupon must often be retained by the rewards issuer or the rewards recipient.

Drawing Description Text (6):
FIG. 4 shows an embodiment of the invention depicting the interaction between an issuer rule registry and the recipient electronic registry where each recipient registry has at least one rewards account from a different issuer.

Drawing Description Text (7):
FIG. 5 shows an embodiment of the invention depicting the interaction between an issuer rule module and the issuer electronic registry where at least one rewards account from a different recipient is stored.

Detailed Description Text (31):
PIA physical security is assured by standard mechanisms. Preferably, these comprise tamper-detect circuitry, an enclosure that cannot be easily opened without visibly injuring the enclosure, erasable memory for critical secrets such as encryption keys, write-once memory for hardware identification, tight integration of all components, and "potting" of exposed circuitry.

Detailed Description Text (43):
In an embodiment, the reward transaction messages between the PIA and the DPC are encrypted. For this, the transaction processor uses the decryption module (DM) 28, which utilizes the hardware identification code of the PIA to identify the encryption codes that is required to decrypt the message from the PIA. Once decrypted, the identity of both parties to the transaction is determined using identification module (IM) 30. TP 26 retrieves the recipient's electronic registry that contains one or more reward accounts. It also retrieves the default rule module

that is identified by the issuer identification (Issuer ID).

Detailed Description Text (45):
In a preferred embodiment, more than one DPCs provide fault tolerance from either natural or man-made disasters. In this embodiment, each DPC uses a backup power generator, redundant hardware, mirrored databases, and other standard fault tolerant equipment known in the industry.

Detailed Description Text (65):
In one embodiment, each BID processor contains the entire database of biometrics. To distribute the transactions evenly across processors without undue effort, the TP determines randomly which BID processor will be used for a given reward transaction, and delegates the identification request to that BID processor. That BID processor then performs a search of its biometric sample database in order to find a matching registered biometric sample.

Detailed Description Text (75):
In a preferred embodiment, the transaction processor 26 receives the identification results from the identification module. Once the recipient and their rewards accounts, as well as the particular rule module that would govern this transaction is located, using the identity of the recipient, the transaction processor locates the recipient's Recipient Electronic Registry (RER). Using the issuer identification data (Issuer ID 64) contained in the transaction request message 60, the transaction processor identifies the issuer's default rule module 62 which contains the instructions for debit or credit of the recipients rewards account. Alternatively, the instruction for debit and credit and various other restrictions on credit or debit of a recipient's reward account is contained in the transaction request message itself 60. Should the transaction request message 60 contain an electronic pointer 68, the default rule module is then overridden and another rule module (rule module P1, P2, etc.) particular to the reward transaction is invoked.

Detailed Description Text (78):
In a preferred embodiment, each issuer rule registry contains at least one issuer rule module 70 (rule module), and any other rule modules associated with that particular issuer. An issuer rule registry is associated with an issuer's identification data.

Detailed Description Text (81):
An electronic pointer (electronic pointer) is an electronic instruction attached to a reward transaction message 60 which directs the TP 26 to invoke a specific rule module P1, P2, etc., for that particular reward transaction. In a preferred embodiment, in the event an electronic pointer is appended to the rewards transaction message, the particular rule model is invoked, otherwise the default rule module is invoked.

Detailed Description Text (82):
Issuer Rule Module (RM)

Detailed Description Text (83):
In a preferred embodiment, the issuer rule module is a computing module inside the issuer rule registry 70 which is programmed with an issuer's pre-designated criteria for determining how reward-units are credited to or debited from a rewards account, and performs the calculation and settlement for each reward transaction. Criteria can include a recipient's purchasing frequency, spending amounts, recency, demographics, and, where applicable, conditions for reward-units redemption such as expiration dates.

Detailed Description Text (85):
In a preferred embodiment, the execution module 34 generates a message to a rule module to cause the rewards transaction to be settled.

Detailed Description Text (86):
In one embodiment shown in FIG. 4, upon successful identification of both parties by the IM, the TP will use the issuer identification data 64 to direct the execution module to invoke a rule module in a particular rewards transaction. In one

embodiment, the recipient electronic registry, the issuer rule registry, and the issuer electronic registry databases are within the DPC. In another embodiment, the DPC communicates with at least one external computer system containing any one of the recipient electronic registry, the issuer rule registry or the issuer electronic registry.

Detailed Description Text (88):
Once the rewards account is located and the applicable rule module is invoked, the reward-units are credited to the rewards account or debited from the rewards account depending upon the criteria specified in the rule module pertinent to the particular transaction. In the event there is insufficient reward-units in the rewards account for a rewards debiting transaction to be settled, the transaction is "declined".

Detailed Description Text (102):
In addition, the issuer registers at least one rule module which defines criteria and amounts for crediting or debiting a rewards account. The criteria or conditions can include a recipient's purchasing frequency, expenditure amounts, recency, expiration dates, demographics, along with settlement instructions, and any conditions for reward-units redemption.

Detailed Description Text (104):
In an embodiment when an issuer uses multiple rule modules to specify different reward-units calculation and settlement formulae, electronic pointers are registered with the system which designate and invoke the various rule modules.

Detailed Description Text (111):
In a preferred embodiment, a recipient at the point of sale originates a reward transaction in the following manner. First, the recipient submits a bid biometric sample obtained from their physical person by the PIA's biometric sensor. The PIA determines that the biometric sample is non-fraudulent, and then translates and compresses that biometric sample into a format suitable for rapid transmission to the DPC.

Detailed Description Text (116):
Network point of sale transactions are characterized by identifying the recipient using the recipient's bid biometric sample submitted through the recipient's personal PIA, or through a public PIA attached to an ATM or other public terminal. The rewards issuer is a registered network merchant, and is identified through a digital certificate. Thus the recipient is identified through biometrics, while the rewards issuer is identified through the verification of a digital certificate issued by an authorized certifying authority.

Detailed Description Text (118):
The recipient then submits a bid biometric sample obtained from their physical person using the PIA's biometric sensor. The PIA determines that the biometric scan is non-fraudulent, and then translates and compresses that biometric scan into a format suitable for rapid transmission to the DPC. The recipient then enters a PIN code into the PIA keypad. The PIA transmits the biometric-PIN to the DPC for identification, along with the rewards issuer's digital certificate.

Current US Original Classification (1):
705/14

CLAIMS:

1. A method for tokenless authorization of a reward transaction between an issuer and a recipient using an electronic identicator and at least one recipient bid biometric sample, said method comprising the steps of:

a. a recipient registration step, wherein a recipient registers with an electronic identicator at least one registration biometric sample;

b. an issuer registration step, wherein the issuer registers identification data with the electronic identicator;

c. a transaction formation step, wherein an electronic reward transaction is formed between the issuer and the recipient, comprising issuer bid identification data, transaction data, and at least one recipient bid biometric sample, wherein the bid biometric sample is obtained from the issuer's person;

d. at least one transmission step, wherein the issuer bid identification data, the transaction data, and recipient bid biometric sample are electronically forwarded to the electronic identicator;

e. a recipient identification step, wherein the electronic identicator compares the bid biometric sample with at least one registered biometric sample for producing either a successful or failed identification of the recipient;

f. an issuer identification step, wherein the electronic identicator compares the issuer's bid identification data with an issuer's registered identification data for producing either a successful or failed identification of the issuer; wherein upon successful identification of the recipient and issuer, a reward transaction is authorized for debit or credit settlement of reward units from the recipient's rewards account, without the recipient presenting any personalized man-made tokens such as smartcards or magnetic swipe cards.

14. A method for processing tokenless electronic reward-units transfer to a recipient using an electronic identicator and at least one recipient biometric sample, comprising;

a. creating an electronic registry of reward units, having the reward-units disbursed to a recipient based upon the occurrence of predetermined criteria;

b. a recipient registration step, wherein the recipient registers with the electronic identicator at least one registration biometric sample;

c. a recipient identification step, wherein the identicator compares a recipient bid biometric sample with at least one previously registered biometric samples for producing either a successful or failed identification of the recipient; and

d. recipient reward-units issuance step, wherein upon successful identification of the recipient, an electronic reward transaction is conducted without the recipient using any tokens such as plastic cards or man made portable memory devices such as smart cards, or magnetic stripe cards to receive the rewards units.

16. A device for tokenless transaction of electronic reward-units transfer to a recipient using at least one recipient biometric sample, comprising;

a. an electronic identicator for comparing the bid and registered biometric samples of a recipient of reward units, and for comparing the bid and registration identification data of an issuer of reward units;

b. a party identification apparatus for submission of the recipient's biometric samples and the issuer's identification data;

c. an electronic reward registry of reward units, having the reward-units disbursed to a recipients based upon the occurrence of predetermined criteria;

d. a recipient rewards account for storage of accrued reward units; and

e. an execution module for debiting and crediting the recipient reward account based upon the occurrence of predetermined criteria, wherein no man made tokens such as cards or smartcards are presented for the transaction.

18. The device of claim 16 further comprising a rule registry module containing predetermined reward units disbursement instructions.

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L3: Entry 7 of 8 File: USPT May 18, 1999

DOCUMENT-IDENTIFIER: US 5905975 A
TITLE: Computer implemented methods and apparatus for auctions

Brief Summary Text (4):
Auction formats in the art tend generally to be of the sealed-bid or ascending-bid variety. In the standard sealed-bid auction, bidders--in one single bidding round--simultaneously and independently submit bids to the auctioneer, who then determines the auction outcome. In the standard ascending-bid auction, bidders--in a dynamic bidding process--submit bids in real time until no more bids are forthcoming. An ascending-bid format offers the advantage that there is feedback between participants' bids: each bidder is able to infer other bidders' information about the value of the object(s) as the auction progresses and incorporate this information into his subsequent bids. This feedback tends to result in more efficient auction outcomes as well as more aggressive bidding, resulting in higher expected revenues for the seller. However, an ascending-bid format also has the disadvantage that--in complex environments--the auction may last for a long time, and require serious bidders to devote substantially all their time during this extended period of the auction. (For example, some of the ascending-bid auctions conducted by the Federal Communication Commission in 1994-96 have consisted of well over 100 bidding rounds and lasted upwards of three months each. In particular, the D-E-F block broadband PCS auction, which began on Aug. 26, 1996, was still in progress on Dec. 20, 1996, and had already conducted 229 bidding rounds.) In addition, the real-time aspect of the bidding--which gives the standard ascending-bid auction its desirable properties--also implies that any bidder's continued participation (and thus the auction's success) may be imperiled by communication breakdowns or other lapses anytime in the course of the auction. By contrast, while a sealed-bid format does not provide participants the opportunity to respond to their competitors' bids, the auction may be completed much more quickly and requires only a single bid submission by bidders, so participation is less onerous for bidders and may be less susceptible to communication breakdowns.

Brief Summary Text (6):
The present invention, in one respect, is a computerized system which allows flexible bidding by participants in a dynamic auction, combining some of the advantageous facets of the sealed-bid format with the basic advantages of an ascending-bid format. At any point in the auction, bidders are provided the opportunity to submit not only their current bids, but also to enter future bids (to be more precise, bidding rules which may have the opportunity to become relevant at future times or prices), into the auction system's database. Moreover, participants are continually provided the opportunity to revise their bids associated with all future times or prices which have not already been reached, by entering new bids which have the effect of superseding this bidder's bids currently residing in the auction system's database. Thus, at one extreme, a bidder who wishes to economize on his time may choose to enter his entire set of bidding rules into the computerized system at the start of the auction, effectively treating this as a sealed-bid auction. At the opposite extreme, a bidder who wishes to closely participate in the auction may choose to constantly monitor the auction's progress and to submit all of his bids in real time. Most bidders are likely to select an approach somewhere between these extremes: a bidder may enter a preliminary set of bidding rules at the start of the auction, but then periodically choose to revise his bidding rules as information is generated through the auction process. He can avoid the necessity of spending every minute of his time monitoring the auction, but still avail himself of the opportunity to respond to his competitors' bids. By the same token, the auctioneer can run the auction at a faster pace and using smaller bid increments

with the present invention than with a system only permitting contemporaneous bids; no bidder need risk missing a submission deadline and completely losing out on placing desired bids (or being disqualified from the auction), as his bidding rules residing in the auction system database fill in until the bidder chooses to revise them.

Brief Summary Text (7):
In order to obtain the advantages of the invention, each of the bidders uses a dedicated user system and the auction itself is monitored and controlled via an auctioneer's system. The auctioneer's system can communicate messages to each of the user systems. The messages are used to initiate an auction and the message initiating an auction may carry with it information describing the particular auction being initiated. The users may thereafter enter flexible bid information which can include a scalar-value, vector-value or a function. The flexible bid information may be an expression of how many units of object(s) a bidder is willing to purchase at a given price(s), how much money a bidder is willing to pay for the purchase of a given object(s), or any other expression of the willingness-to-pay or value which a bidder places on object(s). Optionally, a bidding rule may also include a limitation (e.g. "I desire up to a quantity of x at a price P, but I do not want any positive quantity at all unless I receive a minimum quantity of y"). Thus, a bidding rule may include an unconditional bid or a contingent bid, and may consist of a function from available information to bid quantities (e.g. a function of the previous bid(s) submitted).

Detailed Description Text (7):
Bidding information may include a bidding rule such as a scalar-value, vector-value or function, and may be an expression of how many units of object(s) a bidder is willing to purchase at a given price(s), how much money a bidder is willing to pay for the purchase of a given object(s), or any other expression of the willingness-to-pay or value which a bidder places on object(s). Optionally, a bidding rule may also include a limitation (e.g. "I desire up to a quantity of x at a price P, but I do not want any positive quantity unless I will receive a minimum quantity of y"). Thus, a bidding rule may indicate the willingness to make an unconditional bid or a contingent bid, and may consist of a function based on available information as to bid quantities (e.g. a function of the previous bids submitted).

Detailed Description Text (8):
A message criterion may be the current message, a future possible message, a set of future possible messages, or a criterion which some future possible messages may satisfy. A response or flexible bid information is a signal or data which may be sent by user i's system to the database for bidder i. A response or flexible bid information may explicitly or implicitly include pairs consisting of: a bidding rule, and a message criterion. The bidding rule in the pair is the desired bidding rule which the bidder would like to be processed in reply to any current or future message satisfying the message criterion of the pair. Optionally, a response may also include other information (e.g. a time stamp, the identity of a bidder, or information used for security purposes). The set of possible responses includes the null response.

Detailed Description Text (26):
If a dynamic auction system in the prior art were used, the auctioneer would periodically announce a price (and quantity being offered) to bidders, and bidders would be provided with a deadline by which they must provide a contemporaneous bid consisting of a desired quantity of shares. There is no scope for a bidder to send a response which includes desired quantities at subsequent prices as well (e.g., "I desire 40,000 shares at a price of $10; 35,000 shares at $11; 30,000 shares at $12"). There is also no scope for a bidder to submit a bidding rule (e.g., "I desire 60% of the quantity which Company XYZ demanded at the previous price"). Typically, there is also no scope for a bidder to submit a bid which includes a limitation (e.g., "I desire up to 30,000 shares at $12, but do not want any shares unless I will receive a minimum of 10,000 shares").

Detailed Description Text (27):
Utilizing the present invention, the auctioneer might begin a computerized auction

by transmitting a "message" indicating that he is willing to sell 1,000,000 shares at $10 apiece. Bidders are permitted to input "responses" consisting of bidding rules (including limitations, if desired) for both the current price and subsequent prices as well. Each response resides in the user database until such time that either it is called upon by the auctioneer (i.e., when the subsequent price is reached by the auctioneer) or it is added to, deleted, or modified by the bidder.

Detailed Description Text (40):
Observe that Bidder 1's old bidding rule at $12 remains active in the database for user i. At a given time, the auctioneer queries the user database and accesses the quantity which each bidder demands at $12. Since 1,200,000 shares are being offered at $12, the auctioneer would determine that Bidder 1 is willing to purchase 34,000 shares. The auctioneer might then sum up the quantities demanded by all the bidders and announce that 1,800,000 shares were demanded at $12 (i.e., the issue continues to be somewhat oversubscribed at $12 per share).

Detailed Description Text (42):
Finally, observe that the securities firm may determine that it is feasible, with the present invention, to run the auction using very small bid increments (e.g., $0.01 increases at a time). Although the use of such small steps may require the auction to run several hundred iterations, the fact that the present invention allows the submission of bidding rules for future messages may still enable the completion of the auction in as short a time as one business day. To the extent that the present invention allows smaller bid increments to be used, the securities firm can expect to realize greater revenues from the auction.

Detailed Description Text (44):
FIG. 3D shows that the auctioneer's system 10 includes, within the data portion 16 of the memory 14, an auctioneer's listing of a sequence of value pairs. Each value pair includes an amount representing a number of shares of stock or other objects offered and a value parameter indicating the offered price for the number of objects. The table T containing the auctioneer's listing is sequentially addressed so long as the auction continues and the data at each addressed location is used as the messages which are sent to the user systems 20-40 as the auction progresses. These data values are also, at the same time, loaded into register R1, for the amount in a register R2 for the value. When each of the user databases have been queried for a quantity (or when the users participating in an auction have entered bids), the register S stores the sum of those quantities, i.e. the total number of objects demanded by the bidders. A comparator M then compares the amount offered, from the register R1, with the value in the register S. Logic element D then branches based on the result. A strictly-less-than comparison indicates, in this auction, that the bidders have demanded more objects than have been offered and therefore the auction should continue. Step I is first performed to increment the counter C so as to address the next sequential location from which data may be extracted to make up the messages to be transmitted to the user systems, as is indicated by the arrow to step 101 (FIG. 3A). On the other hand, if the branch indicates a greater-than-or-equal-to comparison, then the logic flow proceeds to step 106 (FIG. 3A) for the transmission of the final message indicating that the auction has been completed. Optionally, if a strictly-greater-than comparison was found, i.e. supply exceeded demand at the final price tested but supply was less than demand at the penultimate price tested, then the system would proceed to follow additional steps to ration objects among the users in accordance with the auction rules.

Detailed Description Text (50):
This initial bidding rule might be sufficiently flexible that Bidder 2 would never find any need to submit any further "response" at any later time in the auction. However, Bidder 2 would always maintain the right to enter a superseding response later in the auction if, for example, he thought the interest rate was becoming absurdly low.

Detailed Description Text (54):
Even more so than in the previous examples, the dynamic auction process could potentially require a very large number of iterations, and so would probably only be feasible if the turnaround time for each round was quite short. However, by

utilizing the present invention, the auction system could incorporate the submission of bidding rules treating subsequent proposed pricing configurations, and so the turnaround time would not necessarily be restricted by the bidders' ability to prepare and submit new bids following each adjustment in the pricing configuration.

Detailed Description Text (80):
Finally, we are ready to define the outcome of the entire procedure of simultaneous auctions and subauctions. Let X denote any subset of the set of available objects, and let .about.X={A,B}.backslash.X denote the complement of X, i.e., .about.X is the set consisting of all the available objects other than those contained in set X. Then the alternative auction procedure concludes with X assigned to Bidder 1 and .about.X assigned to Bidder 2 provided that Bidder 1 wins Bidder 1's Auction for X and Bidder 2 wins Bidder 2's Auction for .about.X. In Example A, observe from Table 1B that the unique X which satisfies this criterion is {A,B}; that is, Bidder 1 wins Bidder 1's Auction for {A,B}, and Bidder 2 wins Bidder 2's Auction for .0.. Finally, our payment rule shall be that Bidder 1 pays the final price which is reached in Bidder 1's Auction for X, and Bidder 2 pays the final price which is reach in Bidder 2's Auction for .about.X. Thus, in Example A, Bidder 1 pays 50 and Bidder 2 pays 0, fully replicating the outcome of the Vickrey auction.

Detailed Description Text (98):
The basic ingredient of the efficient auction for three bidders is to first consider the bidders pairwise. For each pair (j,k) of bidders, and for each subset W of the set of available objects, we conduct a "virtual auction" according to the procedure of Subsection 2, above. The outcomes of these virtual auctions provide the efficient assignment of the objects in W--if they were to be allocated only among Bidders j and k--as well as lower bounds on the values associated with the efficient assignments. (As we will see later, if more precise bounds are needed concerning the values associated with the efficient assignments, the virtual auctions can be restarted.) Second, we conduct another series of virtual auctions, which this time place Bidder i in competition with the combination of Bidders j and k, again using the procedure of Subsection 2. When the second series of virtual auctions is completed, the auctioneer has elicited the efficient allocation among Bidders i, j, and k, as well as how much of a payment to assess Bidder i. Performing these steps, for each of i=1, 2, 3, the auctioneer obtains all of the information needed to implement the outcome rule of the Vickrey auction. However, since the procedure of Subsection 2 was followed, the auctioneer avoids being unnecessarily intrusive in eliciting the values of the high bidders, providing the same advantages as before.

Detailed Description Text (114):
If bidders' values are in general position, and if the inquiry prices are increased in sufficiently small increments, we have seen that the general auction procedure leads to the unique allocation and payments of the Vickrey auction. With complete information or with independent private values, it immediately follows that sincere bidding is a dominant strategy. Observe that this statement holds true regardless of the pacing of the auction, as the pacing rules have no effect on the auction-determined allocation and payments. However, the pacing of the auction will affect the precise questions which are directed to bidders, and so the pacing rules will affect which information is elicited in the auction and which information remains confidential.

Detailed Description Text (116):
Many applications of the efficient auction for dissimilar objects may seem inordinately cumbersome, on account that, with M objects, each bidder is required to determine a valuation for each of 2.sup.M-1 subsets of objects. However, let me now briefly describe one example of a potential application where the operation of the auction could be quite straightforward. Suppose that the Government wished to auction a collection of M television licenses in a city, and the Government enforced a regulation limiting each buyer to holding at most one television license in the city. Observe that it is probably sensible to view this as a dissimilar-object auction, since (at least with current technology), some television frequencies are more desirable than others. Moreover, in a larger setting, bidders may value different television channels differently, depending on what channel a given bidder already holds in other cities.

Detailed Description Text (132):
For example, recall in Example A that Bidder 1 valued {A,B} at 260, but in order to convince Bidder 2 that Bidder 1 was the valid high-value user, it was only necessary to convey to Bidder 2 that Bidder 1 valued {A,B} at some amount greater than 50. Moreover, under the auction rules, the price paid by Bidder 1 is 50. Then, provided that Bidder 1 trusted the auctioneer, Bidder 1 might feel comfortable disclosing his true value of 260 to the auctioneer, knowing that the auctioneer would not reveal this fact to Bidder 2 (provided that Bidder 1 is assigned both objects). Similarly reasoning applies in Examples B and C. The question is how the auctioneer can systematically generate the requisite minimal amount of information; application of the "Two-User Auction for Multiple Dissimilar Objects" provides a systematic method of generating the minimal information to disclose.

Detailed Description Text (148):
FIG. 8 displays the flow of one embodiment of a computerized implementation of the generalized English auction, where the bidding effectively occurs in real time. The auction begins at step 801 where the user systems receive new bids, if any, from users and transmit the new bids to the auctioneer's system. Bids comprise pairs (S,P), where S.OR right..OMEGA. is a subset of the set of all items being auctioned and P is a price which the user is offering to pay for the subset S. Stated differently, a bid comprises a set of objects and an associated price for the bundle. The auctioneer's system then executes the step 802 of determining a solution to the problem of maximizing bid revenues: find an n-tuple, {(S.sub.1,P.sub.1), . . . , (S.sub.n,P.sub.n)} of bids, one from each user i(i=1, . . . ,n), which maximizes the sum P.sub.1 +. . . +P.sub.n, subject to the constraint that the S.sub.i are disjoint subsets of .OMEGA.. Stated differently, for every i(i=1, . . . ,n) and for every j.noteq.i(j=1, . . . ,n), it is required that (S.sub.i,P.sub.i) be a new or previous bid of user i, (S.sub.j,P.sub.j) be a new or previous bid of user j, and S.sub.i .andgate.S.sub.j =.O slashed., i.e. no object of set S.sub.i is a member of the set S.sub.j if i.noteq.j. In performing this calculation, the auctioneer's system may take as implicit the existence of a zero bid, i.e. the pair (.O slashed.,0), associated with each user. Let M denote the maximized sum P.sub.1 +. . . +P.sub.n and let (S.sub.1, . . . , S.sub.n) denote an assignment of objects which attains this maximum. Step 803 is then performed to determine if the auction should continue. One exemplary way to perform step 803 is to compare the current maximized bid revenues M with a function of the maximized bid revenues obtained in previous iteration(s) of the loop, and to continue the auction if and only if the current maximized bid revenues exceed the function of the maximized bid revenues obtained in previous iteration(s). However, this particular stopping rule is only exemplary, and many other embodiments are also possible. If branch 803 determines that the auction should continue, then the processing proceeds to step 804, at which the auctioneer's system generates message(s) based on the bid information and transmits message(s) to user system(s), optionally for display to users. One exemplary way to perform step 804 is to generate for one or more user systems i a message which comprises the entire list of new bids which were received from users other than i, and to transmit said message to user system i. A second exemplary way to perform step 804 is to generate a message which comprises the current maximizing n-tuple, {(S.sub.1,P.sub.1), . . . , (S.sub.n,P.sub.n)}, and to transmit this message to one or more users. However, these particular examples of step 804 were only illustrative, and many other embodiments are also possible. Thereafter, the processing returns to step 801 and the loop is repeated.

Detailed Description Text (150):
Several notes may helpfully be made about the auction of FIG. 8. First, observe that in the preferred embodiment, users are allowed to enter more than one bid. However, in the solution determined in step 802, only one bid by each user (including, possibly, the zero bid) is actually included in the revenue-maximizing n-tuple. Thus, if a given user is interested in purchasing both item A and item C, it would not be advisable for this user to exclusively submit bids of the form ({A},P.sub.A) and ({C},P.sub.C). Rather, it would be prudent to also submit bids of the form ({A,C},P.sub.AC), since it is only by submitting bids on {A,C} or supersets thereof that it is possible to win both A and C. Second, in the preferred embodiment, the maximization calculations and assignments are based on all of the new and previous bids which have been entered at any point in the auction, i.e. bids once entered may never be withdrawn. (Note, though, that the rules may allow submission of bids of

the form (.O slashed.,P), where P>0, which is perhaps logically equivalent to a bid withdrawal with a penalty P.) However, other reasonable embodiments are also possible, including: bids are freely withdrawable in case of error; bids are freely withdrawable at any time, unless they are part of the current revenue-maximizing n-tuple; and bids are withdrawable subject to the penalty of paying the difference between the final maximized bid revenues with the withdrawn bid(s) and the final maximized bid revenues without the withdrawn bid(s). Third, in the preferred embodiment, as many bids as desired may be entered, without limitation. However, other reasonable embodiments are also possible, including: only bids which would become part of the revenue-maximizing n-tuple (given the other previous bids) are allowed to be entered; only bids greater than previous bids by the same user may be entered; no more than K bids (where K is a positive constant) may be entered, e.g. in order to limit computational complexity; only bids for particular subsets of .OMEGA. may be entered; and (as in the FCC auctions) current bidding activity is limited by the magnitude of previous bidding activity or the magnitude of upfront payments made by the particular user. Fourth, in the preferred embodiment, the exemplary stopping rule involves a comparison between current maximized bid revenues and a function of previous maximized bid revenues. However, as will also be seen in FIG. 10, other reasonable embodiments are also possible, including: the auction stops when no new bids are submitted by any user; the auction stops when no new bids and no bid waivers are submitted by any user; or the stopping rule is a function of time. Fifth, in the preferred embodiment, the maximization problem solved was literally to determine an n-tuple of compatible bids which maximize the sum of prices. However, other reasonable embodiments are also possible, including: the maximization problem includes one or more reserve prices which must be exceeded or some of the objects are not sold; the maximization problem is only approximately solved; or the maximization problem involves a maximand which is a somewhat different function from the sum of the bids. Finally, in the preferred embodiment, the payment of user i equals the associated price P.sub.i in the final revenue-maximizing n-tuple. However, other reasonable embodiments are also possible, including that the final payments are a somewhat different function of the entered bids.

Detailed Description Text (153):
As illustrated in FIG. 9, the auction begins at step 821 where the user systems receive new bids, if any, from users and transmit the new bids to the auctioneer's system. Bids comprise pairs (Q,P), where Q=(Q.sup.1, . . . ,Q.sup.m) is a vector consisting of a quantity of each of the m(m.gtoreq.1) respective types of objects being auctioned and P is a price which the user is offering to pay for the collection Q of objects. Stated differently, a bid comprises a quantity for each of the types of objects and an associated price for the bundle. The auctioneer's system then executes the step 822 of determining a solution to the problem of maximizing bid revenues: find an n-tuple, {(Q.sub.1,P.sub.1), . . . , (Q.sub.n,P.sub.n)} of bids, one from each user i(i=1, . . . ,n), which maximizes the sum P.sub.1 +. . . +P.sub.n, subject to the constraint that Q.sub.1 +. . . +Q.sub.n .ltoreq.A, where vector A=(A.sup.1, . . . ,A.sup.m) denotes in its components the available supply of each of the m types of objects. Stated differently, for every i(i=1, . . . ,n), it is required that (Q.sub.i,P.sub.i) be a new or previous bid of user i, and the number of units of each type demanded by the users in aggregate must be less than or equal to the supply. In performing this calculation, the auctioneer's system may take as implicit the existence of a zero bid, i.e. the pair (0,0), associated with each user. Let M denote the maximized sum P.sub.1 +. . . +P.sub.n and let (Q.sub.1, . . . ,Q.sub.n) denote an assignment of objects which attains this maximum. Step 823 is then performed to determine if the auction should continue. One exemplary way to perform step 823 is to compare the current maximized bid revenues M with a function of the maximized bid revenues obtained in previous iteration(s) of the loop, and to continue the auction if and only if the current maximized bid revenues exceed the function of the maximized bid revenues obtained in previous iteration(s). However, this particular stopping rule is only exemplary, and many other embodiments are also possible. If branch 823 determines that the auction should continue, then the processing proceeds to step 824, at which the auctioneer's system generates message(s) based on the bid information and transmits message(s) to user system(s), optionally for display to users. One exemplary way to perform step 824 is to generate for one or more user systems i a message which comprises the entire list of new bids which were received from users other than i, and to transmit said message

to user system i. A second exemplary way to perform step 824 is to generate a message which comprises the current maximizing n-tuple, {(Q.sub.1,P.sub.1), . . . , (Q.sub.n,P.sub.n)}, and to transmit this message to one or more users. However, these particular examples of step 824 were only illustrative, and many other embodiments are also possible. Thereafter, the processing returns to step 821 and the loop is repeated.

Detailed Description Text (155):
It should be observed that there exist many other embodiments of this auction design with inessential differences. FIG. 10 illustrates one such alternative embodiment, which differs from FIG. 8 (FIG. 9) in that the order of steps 802 and 803 (steps 822 and 823) have been reversed. The auction of FIG. 10 begins at step 841 where the user systems receive new bids, if any, from users and transmit the new bids to the auctioneer's system. Step 842 is then performed to determine if the auction should continue. One exemplary way to perform step 842 is to determine whether any new bids have been received. However, this particular stopping rule is only exemplary, and many other embodiments are also possible. If branch 842 determines that the auction should continue, then the processing proceeds to step 843. At step 843, the auctioneer's system determines a solution to the problem of maximizing bid revenues: find an n-tuple of compatible bids, one from each user i(i=1, . . . ,n), which maximizes the sum P.sub.1 +. . . +P.sub.n. Then, at step 844, the auctioneer's system generates message(s) based on the bid information and transmits message(s) to user system(s), optionally for display to users. Thereafter, the processing returns to step 841 and the loop is repeated.

Detailed Description Text (169):
We have now seen how the rules of the generalized English auction for multiple dissimilar objects can be implemented on a flexible bidding system. Before proceeding, it is helpful to observe that dynamic auction designs for multiple dissimilar objects can also be implemented in a superior fashion on the inventive system. Consider, for example, the FCC auction, already discussed above. If we use exactly the same diagram (FIG. 11, above) as we used for the generalized English auction, but we interpret two of the blocks slightly differently, we have an illustration of how to implement the FCC auction on the flexible bidding system.

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